
NASA-15195 (December 2003)
NATIONAL AERONAUTICS NASA
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(March 2003)

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12/03

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SECTION 15195

NATURAL GAS SYSTEMS
12/03

NOTE: Delete, revise, or add to the text in this
section to cover project requirements. Notes are
for designer information and will not appear in the
final project specification.

This section covers natural gas systems at 100
pounds per square inch, gage (psig) 690 kilopascal
or less, utilizing existing site supply and
including aboveground and underground piping systems
and components.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104 (1995) Cement-Mortar Lining for
Ductile-Iron Pipe and Fittings for Water

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Specification for Filler Metals for
Brazing and Braze Welding

AWS WHB-2.8 (1990; 8th Ed) Welding Handbook; Volume
Two - Welding Processes

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.11-2001	(1996) Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.3	(1998) Malleable Iron Threaded Fittings Classes 150 and 300
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1995) Power Piping
ASME B31.8	(1992; Addenda B31.8a-1993) Gas Transmission and Distribution Piping Systems
ASME B40.100	(1998) Pressure Gauges and Gauge Attachments Incorporating ASME B40.100-1998 and ASME B40.7-1992

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2001) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 181/A 181M	(1995; Rev B) Standard Specification for Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron
ASTM A 234/A 234M	(2000) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperatures
ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)

ASTM A 53	(1999; Rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 666	(1994; Rev A) Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A 694/A 694M	(1995; Rev A) Standard Specification for Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Service
ASTM B 280	(1999; e1-2000) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(1999) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(1999) Standard Specification for Seamless Copper Water Tube (Metric)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-83	(1995) Steel Pipe Unions Socket Welding and Threaded
MSS SP-86	(1987; R 1992) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2002) National Fuel Gas Code
NFPA 70	(2002) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-F-1183/GEN	(Rev J; Supple 1A) Fittings, Pipe, Cast
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Bronze, Silver-Brazing, General
Specification for

MS MIL-L-25567

(Rev D; Am 1) Leak Detection Compound,
Oxygen Systems (Metric)

MS MIL-V-12003

(Rev F; Am 1) Valves, Plug: Cast-Iron or
Steel, Manually Operated

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-C-530

(Rev C) Coating, Pipe, Thermoplastic Resin

FS QQ-B-654

(Rev A; Notice 1) Brazing Alloys, Silver

UNDERWRITERS LABORATORIES (UL)

UL 125

(1993) UL Standard for Safety Valves for
Anhydrous Ammonia and LP-Gas (Other than
Safety Relief)

UL 842

(1993; 7th Ed) UL Standard for Safety
Valves for Flammable Fluids

UL 860

(1993) UL Standard for Safety Pipe Unions
for Flammable and Combustible Fluids and
Fire-Protection Service

1.2 GENERAL REQUIREMENTS

NOTE: If Section 15003, "General Mechanical
Provisions," is not included in the project
specification, applicable requirements therefrom
should be inserted and the following paragraph
deleted.

Section 15003, "General Mechanical Provisions," applies to work specified
in this section.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions
in Section 01330, "Submittal Procedures," and edit
the following list to reflect only the submittals
required for the project. Submittals should be kept
to the minimum required for adequate quality
control. Include a columnar list of appropriate
products and tests beneath each submittal
description.

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for in accordance with paragraph entitled, "General Requirements," of this section.

Installation drawings shall be submitted for natural gas systems in accordance with the paragraphs entitled, "Underground Piping Systems Installation" and "Aboveground Piping Systems Installation," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Piping Materials
Valves
Piping Specialties

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with paragraph entitled, "Testing," of this section.

Pneumatic
Leakage
Pressure

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Piping Materials
Valves
Piping Specialties

1.4 GENERAL REQUIREMENTS

NOTE: If Section 15055, "Welding Mechanical," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

[Section 15055, "Welding Mechanical," applies to work specified in this section.]

Fabrication Drawings shall be submitted for natural gas systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

PART 2 PRODUCTS

2.1 UNDERGROUND PIPING MATERIALS

2.1.1 Piping Types

Ells and tees shall be of the same type and class of material as the pipe.

NOTE: Type BCS-PS materials are suitable for natural gas systems 100 psig 700 kilopascal and less, all butt weld (no flange, no thread) construction.

Anode and rectifier cathodic protection should be used to protect against rapid point metal loss due to failure to detect a fault or holiday.

In sizes 1/8 inch through 1-1/2 inches DN6 through DN40, seamless carbon-steel iron pipe size (ips) pressure pipe may be specified at a cost increase of 3 to 5 times.

Type BCS-PS: Black carbon steel piping with polyethylene sheath shall conform to ASTM A 53, Type [E electric resistance welded] [S seamless]. In sizes through 10-inch DN250 iron pipe size (ips), pipe shall have Schedule 40 wall. In size 12 inches DN300 and larger, pipe wall shall be 0.375 inch 10 millimeter thick.

Thermoplastic sheath shall conform to FS L-C-530. Sheath joints shall be made with thermally fitted shrinking sleeves applied with factory-approved shrinking devices. Taped fitting protection and repairs shall be made in accordance with manufacturer's instructions. Electrical flaw detection testing at the factory shall require 10,000 volts to be impressed across the sheath. Sheath breakdown voltage shall be not less than 13,000 volts.

Fittings shall be long-radius butt weld carbon steel conforming to ISO 7005-2, MSS SP-86, ASTM A 234/A 234M and ASME B16.1 to match pipe wall thickness. Bending of pipe is not permitted. Aboveground terminal fittings shall be 150-pound 1050 kilopascal working steam pressure (wsp) forged steel, weld neck flanges to match wall thickness, conforming to ASTM A 694/A 694M, ASME B16.5, and ASTM A 181/A 181M, Class 60.

2.1.2 Natural Gas Shutoff Valve Assemblies

Lubricated plug valves

**NOTE: Where welded end connections are required,
rewrite to: require ASTM A 216, Grade WCB carbon
steel bodies; revise body rating; delete cylindrical
plug valves.**

Valves shall be Type 1, Style [A] [B], taper plug type rated for not less than 175 pounds per square inch (psi) 1200 kilopascal water, oil, or gas (wog) service and shall conform to MSS SP-86 and MS MIL-V-12003.

Valves shall be cylindrical plug type, constructed to service pressure and materials requirements specified for taper plug valves. In addition, clearance between plug and body sealing surfaces shall be 2 mils 0.0508 millimeter, maximum, for valves to 2-inch DN50 ips and 3 to 5 mils 0.075 to 0.127 millimeter for larger valves. Plug stem seal and bottom support shall be reinforced tetrafluoroethylene, and plug shall be bottom spring loaded.

[Plug shall be restricted port type unless full ports or proportioning ports are specified.]

[Valves shall be provided with screwed end connections for all sizes 1-inch DN25 ips and smaller and with flanged connections for all larger valves.]

Valves shall have an effective sealing and lubrication system which, when actuated, forces movement of plug within seating surfaces.

Extended lubricant lines with check valves shall be provided for grease gun access at grade. Lubricant shall be identified and sufficient quantity provided to lubricate each valve at least once.

T-handle extension operators adapted to valve stem shall be provided for sizes 6-inch DN150 ips and smaller.

T-handle extensions and worm and gear operator shall be provided for valves 8-inch DN200 ips and larger. Operator shall not require input of more than 50 foot-pounds 70 newton-meter of torque, shall be totally enclosed, grease packed, and sealed for 20-foot 6000 millimeter head submerged service in brackish water. Worm and shaft shall be steel, gear shall be bronze. Worm shaft shall be mounted in bronze sleeve bearings. Operator shall have open and close stops and plug position indication.

All external surfaces shall be coated with bituminous sealer conforming to AWWA C104.

2.1.1.3 Valve Boxes

Valve boxes shall be of not less than 3/16-inch 5 millimeter thick cast-iron construction with locking cover with an appropriate identification legend. Cover shall require a special wrench for access. Boxes shall be adjustable extension type with screw- or slide-type adjustment. Valves 3 inches DN75 and under shall be fitted with 4-1/4-inch 108 millimeter diameter shaft. Valves 4 inches DN100 and larger shall be fitted with 5-1/4-inch 133 millimeter diameter shaft. Bases shall be

fitted to the valve. Box full-extended length shall be greater than required by depth of cover by not less than 4 inches 100 millimeter. One valve-operating wrench shall be supplied for each size of valve wrench nut.

Guide rings shall be provided where operating rods are longer than 6 feet 1800 millimeter. Internal and external surfaces shall be coated with bituminous sealer conforming to AWWA C104.

2.2 ABOVEGROUND PIPING MATERIALS

Type BCS-NG: Black carbon steel

Pipe (1/8 inch through 10 inches (DN6 through DN250 and where indicated): Schedule 40 seamless or electric resistance welded black carbon steel, conforming to ASTM A 53, Grade B, Type [E] [S]

Pipe (12 inches and over): 0.375-inch (DN300 and over): 10 millimeter wall seamless black carbon steel, conforming to ASTM A 53, Grade B, Type [E] [S]

Fittings (1 inch (DN25 and under): Class 150 banded black malleable iron screwed, conforming to ASTM A 197/A 197M, ASME B16.3 and ASTM A 234/A 234M

Unions (1 inch (DN25 and under): Class 250 female, screwed, black malleable iron with brass to iron seat and ground joint, conforming to ASME B16.39 MSS SP-83 and UL 860

Couplings (1 inch (DN25 and under): Heavyweight screwed black carbon steel

Fittings (1-1/4 inches (DN32 and over): Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness, or steel socket weld, conforming to ASTM A 105/A 105M and ASME B16.11-2001 rated at 2,000 psi 14 Megapascal wog

Flanges (1-1/4 inches (DN32 and over): Class 150 forged steel socket or welding neck to match pipe wall thickness, and conforming to ASME B16.5 and ASTM A 694/A 694M

Type CPR-NG: Copper; natural gas vent and control and instrumentation system tubing; 30 psig 200 kilopascal and less

Tubing (all sizes with 1/4-inch DN8 outside diameter minimum): Hard drawn or annealed seamless copper conforming to ASTM B 280, UNS C12200 conforming to ASTM B 88 ASTM B 88M.

Fittings (all sizes 1/4 inch DN8 and up): Socket joint wrought copper, conforming to ASME B16.11-2001. All fitting cup depths and tolerances shall conform to MS MIL-F-1183/GEN MSS SP-86.

SAE 45-degree flare type, rod or forged brass conforming to SAE [72] [88], used only in exposed-to-view accessible places

Brazing rod [Type 3, conforming to FS QQ-B-654]
(silver solder) [Type BCuP-5 conforming to AWS A5.8]

2.3 PIPING SPECIALTIES

2.3.1 Appliance Connectors

Connectors shall be corrugated bronze metal with brazed inverted flare-type brass fittings complete with transition for ips connection. Maximum length shall be 6 feet. 1800 millimeter. Connectors shall be AGA-approved type.

2.3.2 Natural Gas Pressure-Reducing Station

NOTE: The following covers regulators to 2-inch
DN50 ips, reducing pressures from 2 psi 14 kilopascal.

Where pounds-to-pounds kPa-to-kPa regulators are
required and where double staging for inlet
pressures in excess of 25 psi 175 kilopascal is
required, write specification to suit project
application.

Drawing schedule shall include specific gravity,
temperature, inlet pressure, outlet pressure if
other than specified, and capacity in standard cubic
feet per hour (scfh) cubic meter per minute.

When station is located outside, show concrete,
locking manhole covers, etc.

2.3.2.1 Pressure-Reducing Station

Pressure-reducing station shall be installed complete with a three-valve bypass-valved pressure indicator upstream of station, and valved pressure indicator downstream of station. Bypass valve shall have a proportioning port opening and shall be fitted with a locking device. All system components shall be of the size, capacity, and pressure-reduction capability indicated.

2.3.2.2 Pressure Regulator and Accessories

Pressure regulator shall be service-type, complete with automatic low-pressure cutoff and automatic pressure relief. Shop drawing shall be submitted and shall include performance curves.

NOTE: Normal spring ranges include: 3.5 to 6.0
inches; 90 to 150 millimeter; specified range: 6.0
to 14 inches 150 to 350 millimeter.

Body shall be cast iron. Valve shall be capable of shutting off under supply pressures to 100 psi 700 kilopascal. Valve spring range shall be 5.0 to 8.5 inches 125 to 215 millimeter water gage (wg), and set point shall be 7 inches 180 millimeter. Outlet pressure shall vary by not more

than 1/2-inch 13 millimeter wg from the set point over the capacity range of the regulator.

Pressure relief shall be diaphragm-operated, spring-loaded type with vent for relief of excess pressure. Release set point shall be 12 inches 305 millimeter wg.

Low-pressure cutoff regulator shall be adjustable to shut off gas supply entirely if pressure drops below set point. Supply shall remain shut off until manual reset of regulator takes place.

Pressure regulator diaphragm vent and pressure relief vent shall be run as separate, jointless, full size vent lines connected to the vent tapping and terminating at an approved outside location with weatherproof, bugproof, screened vent cap.

2.3.3 Pressure Gages

Pressure gages shall conform to ASME B40.100, Type I, Class 1. Pressure-gage size shall be 3-1/2-inch 90 millimeter nominal diameter. Case shall be corrosion-resistant steel conforming to any of the AISI 300 series of ASTM A 666, with a No. 4 standard commercial polish or better. All gages shall be equipped with adjustable red marking pointer and damper screw adjustment in inlet connection.

2.3.4 Line Strainers

Strainers shall be Y-type with removable basket. Strainers in sizes 2-inch DN50 ips and smaller shall have screwed ends; sizes 2-1/2-inch DN65 ips and larger shall have flanged ends. Body working pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainer shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Body material shall be cast bronze conforming to ASTM B 62 or cast iron conforming to Class 30 ASTM A 278 ASTM A 278M. Where system material is nonferrous, strainer body material shall be nonferrous.

Minimum free hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens for natural gas service shall have mesh cloth not to exceed 0.006 inch 0.152 millimeter. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI [Type [304] [316] corrosion-resistant steel] [Monel metal].

2.4 VALVES

2.4.1 Ball Valves (BAV)

Ball valves shall be the fire-seal type, conforming to UL 842 and UL 125.

Valves shall be rated for service at not less than 200 psi at 200 degrees F 1400 kilopascal at 93 degrees C.

Valve bodies in sizes 1-inch DN25 ips and smaller shall be screwed-end type constructed of [ductile iron] [carbon steel] [cast steel].

Valve bodies in sizes 1-1/4-inch DN32 ips and larger shall be flanged-end type constructed of [ductile iron] [carbon steel] [cast steel].

Valve bodies shall have socket weld ends or butt weld ends where indicated to be welded, and body shall be constructed of [carbon] [cast] steel.

Balls and stems shall be Type 316 corrosion-resistant steel.

Valves shall be suitable for flow from either direction and shall seal tightly in either direction.

Valves shall have full pipe size flow areas where noted.

Valve seats and seals shall be tetrafluoroethylene; seats shall have secondary corrosion-resistant steel seating surfaces to effect shutoff should resin be burned out.

Valve body construction shall be such that:

Torque from a pipe with valve in installed condition shall not tend to disassemble the valve by stripping setscrews or loosening body end inserts or coupling nuts.

Torque from a pipe shall be resisted by a one-piece body between end connections or by bolts in shear where body is of mating flange or surface bolted construction.

2.4.2 Diaphragm Control and Instrument Valves (DCIV)

Diaphragm valves in sizes 1/4- and 3/8-inch DN8 and DN10 shall have a forged-brass body with reinforced tetrafluoroethylene diaphragm, AISI 300 series corrosion-resistant steel spring, and round phenolic handle. Handle shall be fitted with color-coded discs.

2.4.3 Gage Cocks (GC)

Gage cocks shall be T-head or lever-handle ground key type with washer and screw, constructed of polished ASTM B 62 bronze, 125 psi 860 kilopascal. End connections shall suit the service, with or without union and nipple.

2.4.4 Nonpressure-Lubricated Gas Stops (LGS)

NOTE: High break-away torque, tendency to freeze,
low cost, maximum shell pressure 85 psi 600
kilopascal.

Gas stops through 1-inch DN25 ips shall have an operating pressure rating of not less than 60 psi 415 kilopascal, gas.

Locking feature shall be provided where noted.

2.4.5 Eccentric Plug Valves (EPV-UL)

NOTE: These valves may be used in lieu of Type LGS valves.

Eccentric plug valve maximum size shall be limited to 3-inch DN80 ips.

Eccentric plug valves shall be constructed with semisteel body, bronze plug with Buna-N resilient elastomer seals. Body sealing face shall be plastic coated. Body end connection shall be screwed for sizes 1-inch DN25 ips and smaller and flanged in sizes through 3-inch DN80 ips. Plug shall be top and bottom guided by oil-impregnated bronze bushings and shall be corrosion-resistant steel spring-loaded. Valves shall be rated at 175-psi 1200 kilopascal wog and shall be UL listed for natural gas service. Valves shall be fitted with pinned lever operators.

Valves shall be provided with locking device where noted.

2.4.6 Lubricated Plug Valves (LPV)

NOTE: Where welded end connections are required, rewrite to: require ASTM A 216, Grade WCB carbon steel bodies; revise body rating; delete cylindrical plug valves.

Valves shall be Type 1, Style [A] [B], taper-plug type, rated for not less than 175-psi 1200 kilopascal wog service and shall conform to MSS SP-86 and MS MIL-V-12003.

Valves may be cylindrical plug type, constructed to service-pressure and materials requirements specified for taper plug valves; in addition, clearance between plug and body-sealing surfaces shall not exceed 2 mils 0.0508 millimeter for valves to 2-inch DN50 ips and shall be 3 to 5 mils 0.076 to 0.127 millimeter for larger valves; plug stem seal and bottom support shall be reinforced tetrafluoroethylene; plug shall be bottom spring loaded.

[Plug shall be full port or restricted port type.]

[Regulator bypass valves shall be provided with proportioning ports and locking feature.]

Valves shall be provided with screwed end connections for all sizes 1-inch DN25 ips and smaller and flanged end connections for all larger valves.

Valves shall have an effective sealing and lubrication system which, when actuated, forces movement of plug within seating surfaces.

Check-valve-type lubrication fittings shall be provided for grease gun lubrication. Lubricant shall be identified and sufficient quantity shall be provided to lubricate each valve at least once.

Worm and gear operator shall be provided for all valves 8-inch DN200 ips and larger. Operator shall not require input of more than 50 foot-pounds 70 newton-meter of torque and shall be totally enclosed, grease packed, and sealed. Worm and shaft shall be steel, gear shall be bronze. Worm shaft shall be mounted in bronze bearings. Operator shall have open and close stops and plug position indications.

Locking feature shall be provided, where noted.

2.4.7 Gasket Material

Gasket material and type shall be in accordance with NFPA 54.

PART 3 EXECUTION

3.1 UNDERGROUND PIPING SYSTEMS INSTALLATION

3.1.1 Installation

Installation of natural gas systems shall be performed in accordance with ASME B31.8 in the presence of the Contracting Officer who shall be notified by the Contractor 48 hours in advance of start of installation.

All excavations shall be dry and clear of extraneous materials when pipe is being laid.

Piping shall be laid beginning at the low point of a system; when in final position it shall be true to the grades and alignment indicated, with unbroken continuity of invert.

[Connection to existing main gas line shall be as noted.]

[Connections between new work and existing gas line shall be made to the satisfaction of the Contracting Officer, using proper specials and fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fitting shall be the same size as the pipe to be connected.]

Gas mains shall be graded for the complete drainage of condensate to drips placed at low points; service lines shall be graded to drain to the main line wherever practical.

[Crossings of gas mains under traffic lanes shall be made as shown.]

[Drips shall be installed where shown and at all low points whether indicated or not. Drips shall conform to the details indicated or shall be of commercial manufacture approved as to type and capacity. A 1-1/4-inch DN32 or larger blowoff pipe shall be connected to each drip at its lowest point and shall extend to or near the ground surface at a convenient

location outside of traffic. Discharge terminal shall be provided with a reducing fitting, plug valve, and 1/2-inch DN15 nipple turned down. Discharge terminal shall be inside a length of 12-inch 300 millimeter or larger vitrified clay pipe or concrete sewer pipe, set vertically on a bed of coarse gravel 1 foot 300 millimeter thick and about 3 feet 1 meter square, and closed at the ground surface with a suitable replacement cover.

When details are not shown, drips shall be made of 6-inch DN150 pipe 12 feet 3700 millimeter long, laid parallel and completely below the gas main and shall be provided with 1-1/4-inch DN32 or larger blowoff as specified above.]

**NOTE: Select the following paragraph only when
drawings do not detail entry.**

[When installed underground beneath buildings, gas piping shall be encased in a conduit that shall extend into a normally usable and accessible portion of the building. At the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the entrance of gas into the building. Conduit shall extend at least 4 inches 100 millimeter outside the building, shall be vented above grade, and shall be installed in a manner that will prevent the entrance of water. Conduit shall be of the same materials as used for the line being enclosed. Vent shall be fitted with a metal identification plate indicating its function.]

Conduit passing through walls below grade and ground floor slab shall pass through pipe sleeves larger than conduit and shall be made watertight.

In fill areas, conduit passing under or through building grade beams shall have a minimum clearance of 4 inches 100 millimeter in all directions to prevent damage.

On excavations occurring near and below building footing, the backfilling material shall consist of Class 2000A concrete poured or pressure grouted up to the level of the footing.

Where pipe penetrates earth or concrete grade, not less than 12 inches 300 millimeter of polyethylene-coated Type BCS-PS pipe shall be exposed to view.

Type BCS-PS materials shall be installed for underground and aboveground piping and in accordance with the manufacturer's instructions. Pipe shall be palletized in padded pallets at the factory and shall be handled from pallet to final position with padded gear. Surfaces shall be protected from the sun with black polyethylene sheeting. Prior to being lowered into a trench, sheeting shall be checked for continuity with 10,000 volts applied by a continuity detector with an audible alarm. In the trench, after joints and fittings have been made, previously untested surfaces shall be checked for continuity. When discontinuities in thermoplastic sheeting are found, not less than 12 inches 300 millimeter of material upstream and downstream of the fault shall be removed and replaced.

[After valves, valve operators, and valve boxes have been inspected, and

not less than 48 hours prior to being lowered into a trench, external surfaces shall be coated with a compatible bituminous coating for protection against brackish ground water.]

Application shall be in accordance with the manufacturer's instructions and shall result in a dry-film thickness of not less than 12 mils 0.30 millimeter.

After pressure testing and approval, valves and valve operators shall be thoroughly cleaned, coated with bitumen, wrapped with tape, and recoated with bitumen to form an impervious membrane. Tape shall be glass-fiber reinforced with parallel strands of continuous filament within the fiber structure, bonded with an insoluble, inert, resinous binder that is compatible with bituminous material used.

Prior to backfilling, coated and wrapped pipe and valves shall be tested with an electric holiday detector operating at from 10,000 to 15,000 volts. Defects shall be repaired by clipping back the coatings to the bare metal and recoating with the materials as specified for the original work and to the satisfaction of the Contracting Officer.

Defective materials found shall be distinctly marked and promptly removed from the site.

3.1.2 Valve Boxes

Valves and valve boxes shall be installed where indicated and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside traffic areas. Soil shall be carefully tamped around each valve box to a distance of 4 feet 1200 millimeter on all sides of the box or to the undisturbed trench face if less than 4 feet 1200 millimeter. Valve boxes located in roads or sidewalks shall be protected by a concrete slab as indicated.

3.2 ABOVEGROUND PIPING SYSTEMS INSTALLATION

3.2.1 Aboveground Piping

NOTE: NFPA 54 covers the installation of gas piping, both in buildings and between buildings from point of delivery (meter, regulator, etc.) To the inlet connection or equipment and gas piping for all industrial installations regardless of the gas pressure and for all other installations operating at pressures greater than 1/2 psig 3.5 kilopascal. Portions of NFPA 54 standards are extracted and included herein.

[Aboveground piping with operating pressures of 1/2 psig 3.5 kilopascal and less, designated "low pressure," shall be fabricated and installed in accordance with NFPA 54, AWS WHB-2.8, MSS SP-69.]

[Aboveground piping with operating pressures in excess of 1/2 psig 3.5 kilopascal, designated "high pressure," shall be fabricated and installed in accordance with ASME B31.8, AWS WHB-2.8 and MSS SP-69.]

Work shall be performed in the presence of the Contracting Officer who shall be notified 48 hours in advance of start of work.

Pipe shall be fabricated to measurements established on the job and shall be carefully worked into place without springing or forcing. Adequate provision shall be made for absorbing all expansion and contraction without stress in any part of the system.

Pipe, tubing, fittings, valves, equipment, and accessories shall be visibly clean and free of foreign material before being installed into the respective systems. Pipe shall be cleaned by hammering, shaking, or swabbing, or by a combination of methods. Lines shall be purged with dry, oil-free compressed air after erection, but purging out shall not be relied upon for removing all foreign matter. Purge velocity shall be equal to 1-1/2 times maximum normal flow velocity. During the progress of construction, open ends of pipe, fittings, and valves shall be properly protected at all times to prevent the admission of foreign matter. Plugs or caps shall be placed in the ends of installed work at all times when connecting work is not actually under way. Plugs shall be commercially manufactured products approved by the Contracting Officer. Outlets, including valve outlets, shall be securely closed gastight with a threaded plug or cap immediately after installation and shall be left closed until the gas equipment is connected thereto.

Piping shall be installed straight and true with approved offsets around obstructions and with expansion bends or fitting offsets essential to a satisfactory installation, and as may be necessary to increase headroom or to avoid interference with the building construction, electric conduit, or facilities equipment.

Natural gas piping smaller than 1/2-inch DN15 ips shall not be concealed.

When installing piping that is to be concealed, the following and similar connections shall not be concealed: unions, tubing fittings, running threads, right and left couplings, and swing joints made by combinations of fittings.

Standard long sweep pipe fittings shall be used for changes in direction; no mitered joints or unapproved pipe bends will be permitted.

[Pipe bends in seamless pipe of not less than 5 pipe diameters radius may be made with hydraulic benders in the field for pipe sizes to 4-inch DN100 ips upon approval of the Contracting Officer.]

[Tee connections shall be made with screwed tee fittings or butt, or, where pipe is being welded, branch connections may be made with either butt or socket welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full

pipe-bursting strength requirements.]

[Short-radius elbows may be used only where specifically authorized by the Contracting Officer.]

**NOTE: Rewrite following paragraph if wet natural
gas will be used. See NFPA standards.**

Horizontal piping shall have a grade of 1 inch per 100 feet 25 millimeter per 31 meter.

Reducers shall be concentric or eccentric. Eccentric reducers shall be used where required to permit proper drainage of pipe lines. Bushings as reducers are not permitted. Drain valves shall be provided in all piping systems at low points.

Installation of piping shall be such as to prevent stresses and strains from being placed on connected equipment.

Dielectric connection shall be provided at inlet side to building pressure regulator.

Expansion bends in steel pipe shall be made from pipe sections and long radius welding elbows in sizes 1 inch DN25 and larger. Expansion U-bends shall be cold sprung and welded into the line, which shall be anchored before removing the spreader from the expansion U-bend. Amount of cold spring shall be as indicated.

3.2.2 Joints

Joints larger than 1-inch DN25 ips shall be welded.

Pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with joint compound.

Joint compounds shall be applied to the male thread only, and care shall be exercised to prevent compound from reaching the interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system.

Flanged joints shall be assembled with appropriate flanges, gaskets, and bolting. Clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system. Flange faces shall be parallel and the bores concentric. Gaskets shall be centered on the flange faces without projecting into the bore. Bolting shall be lubricated with oil and graphite before assembly to ensure uniform bolt stressing. Flange bolts shall be drawn up and tightened in staggered sequence in order to prevent unequal gasket compression and deformation of the flanges. Wherever a flange with a

raised face is joined to a companion flange with a flat face, the raised face shall be machined down to a smooth matching surface and a full face gasket shall be used. After the piping system has been tested and is in service at its maximum temperature, bolting shall be retightened to achieve minimum gasket seating stress recommended by the gasket manufacturer. Only hex-head nuts and bolts shall be used.

Gasket material shall be fresh stock.

Uncoated metallic gaskets shall be assembled with specified compound.

Field-welded joints shall conform to the requirements of the AWS WHB-2.8 and ASME B31.1.

Copper tubing for solder joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Inside surfaces of fittings and outside surfaces of tubes in joint area shall be cleaned with steel wool before assembly of joint. Joint flux, solder, and heat source shall be applied in accordance with the manufacturer's instructions to provide proper capillary action to fill the socket space and to achieve 100 percent shear-line strength. Valves in copper piping shall have screwed ends with end adapters to suit mechanical connections, unless solder jointing is specified or indicated for a given application. Copper joints that fail pressure tests shall be remade with new materials, including pipe or tubing fittings and filler metal.

Copper tubing for mechanical joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Care shall be exercised not to work-harden copper surfaces during flaring and, in case of doubt, tube ends shall be cut off and annealed by heating and air cooling in accordance with the manufacturer's instructions.

3.2.3 Control and Instrument Piping

Tubing shall be mechanically attached to supporting surfaces. Supports using adhesives shall not be acceptable.

Copper tubing horizontal supports for less than three tubes shall be rigid 1- by 3/8-inch 25 by 10 millimeter metal channel and proprietary metal tube race for three or more tubes.

Copper tubing runs in soil shall be jointless and shall be protected from brackish ground water and leaching concrete alkali by 12-mil 0.30 millimeter thick bituminous coating or equivalent PVC tape wrapping.

3.2.4 General Service Valve Locations

Valves shall be located to permit isolation of branch piping and each equipment item from the balance of the system and to allow safe and convenient access without moving equipment and with a minimum of piping and equipment disassembly.

Valves shall be provided in piping mains and branches and at equipment where indicated and where specified.

Three-valve bypasses shall be provided around pressure regulating valves and where indicated.

No valve shall be placed in an inaccessible space.

3.3 NATURAL GAS SYSTEMS TESTING

3.3.1 Tests

Prior to acceptance of the work, the Contractor shall test completed systems in the presence of the Contracting Officer.

NOTE: Due to the expansive force of compressed gases at the 100-psi 700 kilopascal and higher range of pressures normally used, pneumatic testing requires special precautions and competent supervision to guard against injury and damage when a failure occurs.

For critical systems, perform a mixed gas test adapted for natural gas.

Tests shall be Pneumatic and shall utilize dry, oil-free nitrogen. Testing shall be done in two stages, preliminary and acceptance.

Personnel not directly involved in pneumatic testing of ferrous piping in excess of 5 psi 35 kilopascal shall be evacuated from the area.

Testing of any system for any purpose shall include preliminary testing by the process of swabbing of all joints under test with standard high-film-strength soap solution conforming to MS MIL-L-25567, and the subsequent observation for bubbles at internal pressures not in excess of 5 psi 35 kilopascal.

When testing reveals that Leakage exceeds specified limits, the leaks shall be isolated and repaired, defective materials shall be replaced where necessary, and the system shall be retested until specified requirements are met. Leaking gasket joints shall be remade with new gaskets and new flange bolting. Removed bolting and gaskets shall not be used again. Leaking tubing joints shall be remade with new fittings and new tube ends.

Only standard piping flanges, plugs, caps, and valves shall be used for sealing off piping for test purposes.

Components that could sustain damage due to test pressure shall be removed from piping systems during testing. Piping system components such as valves shall be checked for proper operation under system test pressure.

No test media shall be added to a system during a test for a period specified or determined by the Contracting Officer.

Duration of a test will be determined by the Contracting Officer and shall be for a minimum of 15 minutes with a maximum of 24 hours. Tests may be terminated by the Contracting Officer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

Test material shall be retained in piping system after successful testing until purged by natural gas. No ambient air shall be permitted to enter piping system.

Records of piping systems tests shall be prepared and maintained. Records shall show Governmental and Contractor test personnel responsibilities, dates, test gage identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates. Each acceptance test shall require the signature of the Contracting Officer.

3.3.2 Test Gages

Contractor's test gages shall have dial size 4-1/2 inches 125 millimeter or larger with accuracy of plus or minus one-half of 1 percent of full-scale range. Dial graduations and pointer width shall be compatible with readability to one-half the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting point at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to the test, and shall show test gage number and the project number.

3.3.3 Acceptance Pressure Testing

Testing shall take place during steady ambient temperature conditions.

**NOTE: Select 75-psi 520 kilopascal test pressure
when Type LGS valves are specified; otherwise select
150-psi 1050 kilopascal test.**

[Ferrous piping systems shall be tested at 75 psig 520 kilopascal.]

[Ferrous piping systems shall be tested at 150 psig 1050 kilopascal.]

Any reduction of test pressures shall be deemed to indicate the presence of leaks which shall be corrected unless the pressure loss can otherwise be accounted for. A correction of plus or minus 0.3 psi 2 kilopascal will be allowed for each degree change between initial and final system temperature, plus for an increase in temperature and minus for a decrease.

Test duration shall be long enough to determine if there are any leaks but not less than 1 hour for each 500 cubic feet 14 cubic meter of pipe volume or fraction thereof, except that when testing a system having a volume of less than 10 cubic feet 0.3 cubic meter, the test duration may be reduced to 15 minutes. For piping systems having a volume of more than 24,000 cubic feet 680 cubic meter, the duration of the test shall be 24 hours.

Control and instrumentation tubing systems shall be tested at 30 psi 200 kilopascal and the test pressure shall be maintained for a period of not less than 24 hours with no pressure drop.

3.3.4 Purging of Piping

During construction, where necessary, purge valves shall be provided and located to ensure complete system purging with discharge exterior to the building.

3.3.5 Lighting of Pilot Lights

Equipment using natural gas under this Contract shall be lighted in the presence of the Contracting Officer.

3.4 ELECTRICAL WORK

NOTE: Include applicable requirements in Division
16 "Electrical" work.

3.4.1 Electrical Service

[Available power is [480-volt, 3-phase, 60-hertz] [120/240 volts, single-phase, 60-hertz] [_____]. Contractor equipment with voltage requirements other than that specified shall have transformer equipment. Contractor shall refer to the electrical drawings and Division 16, "Electrical," of these specifications for specific information on the arrangement of electrical circuits and their effect on the equipment and work required.]

3.4.2 Electrical Bonding and Grounding

Each aboveground portion of gas piping system upstream of the equipment shutoff valve shall be electrically continuous and bonded to any grounding electrode, in accordance with NFPA 70.

3.4.3 Electrical Circuits

Electrical circuits shall not utilize gas piping or components, except that low voltage (50 volts or less) control circuits, ignition circuits, and electronic flame detection device circuits may use piping or components for a part of an electrical circuit.

An electrically operated normally open safety control shall be provided to shut off the flow of gas if the power fails.

-- End of Section --